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Coanda-effect screens (static inclined screens) are an emerging technology that offers the potential for high-capacity, low-maintenance screening of fish and fine debris from water diversions such as those used for irrigation and small hydropower development. Obstacles to their use have been the relatively large hydraulic head required by commercially available designs, the lack of design tools for developing customized designs that might have lower head requirements, a lack of biological design criteria, and uncertainty regarding their effects on screened fish.

There were two primary objectives for the project. First, the project sought to create design tools that would enable the development of custom screen designs having specific hydraulic performance characteristics. Second, the project sought to use laboratory testing to evaluate the biological effectiveness of Coanda-effect screens for safe screening and downstream passage of fish.

The first objective of the project was met. A theoretical model for Coanda-effect screen hydraulics was created, and a computer program was written to implement the model. This computer program can be used to predict the screened flow and overflow for a full range of potential screen designs. The model was calibrated using test data obtained during this project and from other previous research. The model is most accurate for relatively small amounts of overflow. Testing will be continued under project ER.99.10 (Fish Screens) in FY 2000 to improve the calibration of the model for large-overflow cases.

The second objective of the project was partially met. Biological testing with splittail and with trout representative of smolt-sized salmon was difficult to carry out due to behavioral resistance of the test fish to going over the screen. Fish tended to hold indefinitely in the pool upstream of the screen. Crowding fish over the screen was attempted, but was deemed an unsatisfactory method due to distortion of the flow caused by the crowder. Testing under nighttime conditions and with alternative methods of fish introduction will continue in FY 2000 under project ER.99.10. In the limited tests carried out thus far, no significant ill effects to fish have been observed.

Additional biological testing was performed under a cooperative agreement with Metro Wastewater Reclamation District. These tests used smaller fish, and the fish were introduced on the screen face, rather than in the upstream pool, so the problems of fish holding in the upstream pool were avoided. These tests showed significant loss of the smallest size fish (5-mm and 7.5-mm length fathead minnow fry) through a 1-mm screen. Fish losses were significantly reduced in

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tests of a 0.5-mm screen. There were essentially no losses of fish through the screens for fish of 22.5-mm length or greater. Mortality of the smaller sized fish was also significant. Multi-level control groups were used to attempt to separate mortality sources. Analyses of all these data are ongoing, and additional tests under the cooperative agreement with Metro are planned.

The Water Resources Research Laboratory and Fisheries Applications Research Group were the primary participants. Additional hydraulic testing was conducted under a cooperative agreement with Metro Wastewater Reclamation District – Denver, Colorado, and additional biological tests were carried out in Reclamation's laboratory under a cooperative agreement between Metro and Colorado State University's Larval Fish Lab.

Wahl, Tony L. Hydraulic Performance of Coanda-Effect Screens. [Draft manuscript to be submitted to ASCE Journal of Hydraulic Engineering.]

Wahl, Tony L., and Robert F. Einhellig. Laboratory Testing and Numerical Modeling of Coanda-Effect Screens. [Abstract submitted to ASCE Joint Conference on Water Resources Engineering and Water Resources Planning & Management, Minneapolis, Minnesota, July 30-Aug. 2, 2000.]